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Lisanne Warmerdam [a], Annemieke Van Straten [a], Jos Twisk [b] & Pim Cuijpers [a]

[a] Department of Clinical Psychology and EMGO Institute for Health and Care Research, VU University Amsterdam, Amsterdam, The Netherlands

[b] Department of Methodology and Applied Biostatistics, Faculty of Earth and Life Sciences, Institute of Health Sciences, VU University Amsterdam, Amsterdam, The Netherlands

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Predicting outcome of Internet-based treatment for depressive symptoms

LISANNE WARMERDAM[1], ANNEMIEKE VAN STRATEN[1], JOS TWISK[2], & PIM CUIJPERS[1]

[1]*Department of Clinical Psychology and EMGO Institute for Health and Care Research, VU University Amsterdam, Amsterdam, The Netherlands &* [2]*Department of Methodology and Applied Biostatistics, Faculty of Earth and Life Sciences, Institute of Health Sciences, VU University Amsterdam, Amsterdam, The Netherlands*

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Abstract
In this study we explored predictors and moderators of response to Internet-based cognitive behavioral therapy (CBT) and Internet-based problem-solving therapy (PST) for depressive symptoms. The sample consisted of 263 participants with moderate to severe depressive symptoms. Of those, 88 were randomized to CBT, 88 to PST and 87 to a waiting list control condition. Outcomes were improvement and clinically significant change in depressive symptoms after 8 weeks. Higher baseline depression and higher education predicted improvement, while higher education, less avoidance behavior and decreased rational problem-solving skills predicted clinically significant change across all groups. No variables were found that differentially predicted outcome between Internet-based CBT and Internet-based PST. More research is needed with sufficient power to investigate predictors and moderators of response to reveal for whom Internet-based therapy is best suited.

Keywords: cognitive behavior therapy; problem-solving; depression; predictors; moderators; Web-based

Background

Cognitive behavioral therapy (CBT) and problem-solving therapy (PST) are two efficacious treatments for depression (Butler, Chapman, Forman, & Beck, 2006; Cuijpers, van Straten, & Warmerdam, 2007). The results for both therapies when administered via the Internet are promising (Spek et al., 2007; van Straten, Cuijpers, & Smits, 2008; Warmerdam, van Straten, Twisk, Riper, & Cuijpers, 2008). Little is known about which participant characteristics determine the effectiveness of these therapies; even less is known about what predicts response to Internet-based therapy. In this article, we attempt to examine such characteristics using secondary analyses of a randomized controlled trial comparing Internet-based CBT, Internet-based PST and a waiting list control group for the treatment of depressive symptoms (Warmerdam et al., 2008).

Two ways can be distinguished in which a variable might predict outcome. A variable that predicts outcome irrespective of the treatment is often referred to as a predictor. Predictors can indicate subgroups of individuals who are especially responsive to treatment regardless of the type of intervention. On the other hand, a variable that predicts a different pattern of outcome between two or more treatments is called a moderator (Kraemer, Wilson, Fairburn, & Agras, 2002). When two treatments are found not to differ in outcome, it may still be the case that persons with some participant characteristics react better to one treatment than the other. Such characteristics are of clinical value as they would allow individuals to receive the treatment that is most likely to reduce their depressive symptoms.

Some studies have systematically examined age, gender, marital status, and education as predictors of outcome in traditional CBT. Evidence suggests that being married may be a predictor of better response to CBT (Jarrett, Eaves, Grannemann, & Rush, 1991; Sotsky et al., 1991). Also increased pre-treatment levels of depressive symptoms and dysfunctional attitudes have been shown to predict poorer outcome in CBT (Hoberman, Lewinsohn, & Tilson, 1988; Jarrett et al., 1991; Simons, Gordon, Monroe, & Thase 1995; Sotsky et al., 1991; Thase, Simons, Cahalane, McGeary, & Harden, 1991), while other studies found no correlation between severity of depression and outcome for

Correspondence concerning this article should be addressed to Lisanne Warmerdam, VU University Amsterdam, Department of Clinical Psychology and EMGO Institute for Health and Care Research, Amsterdam, The Netherlands. Email: e.h.warmerdam@vu.nl

cognitive therapy and CBT (Hollon et al., 1992; Shapiro et al., 1994).

There has been only limited research comparing two or more psychological treatments in which moderators of outcome are investigated. And when these analyses are performed, the identified moderators are diverse. Part of the difficulty in detecting moderating variables probably stems from the relatively low statistical power associated with the predictor × treatment interaction effects from different analysis methods (Aguinis & Stone-Romero, 1997). Some studies did find a moderating effect. For example, coping style and defensiveness differentially predicted improvement in cognitive therapy and supportive self-directed therapy; externalizing patients improved more than non-externalizing patients in cognitive therapy, whereas non-externalizing patients improved most in self-directed therapy. And high defensive patients improved more in self-directed therapy than in either focused expressive psychotherapy or cognitive therapy, whereas low defensive patients improved more in cognitive therapy than in self-directed therapy (Beutler et al., 1991). Another study showed that higher attachment avoidance predicted greater reduction in depression severity with CBT compared to interpersonal psychotherapy (McBride, Atkinson, Quilty, & Bagby, 2006). Also, cognitive therapy was more effective in reducing depression for married or cohabiting participants, while single participants reacted better to interpersonal therapy (Barber & Muenz, 1996). One study evaluated whether pre-existing deficits in either problem-solving or life integration are predisposing factors for differential response to PST and reminiscence therapy for depression in older adults (Arean et al., 1993). PST was found to be effective in reducing depressive symptoms for "poor" as well as "good" problem-solvers and for "poor" as well as "good" life integrators. Reminiscence therapy was found to be an effective intervention for "good" as well as "poor" problem-solvers and for "good" life integrators, but not for "poor" life integrators. However, the effectiveness of the treatments for these subgroups was dependent on how depression was measured, in other words, on whether depression was measured with observer-based or self-report measures (Arean et al., 1993).

There are only a few studies that focused on predictors of Internet-based treatment for depression. One study found that higher baseline depression scores, female gender, and low neuroticism predicted better outcome for both group and Internet-based CBT for depression (Spek, Nyklicek, Cuijpers, & Pop, 2008). As with traditional CBT, studies evaluating the role of initial severity of depression on outcome of Internet-based treatment show mixed results; in a trial evaluating Internet-based CBT for mild to moderate depression it was found that the number of previous episodes of depression was negatively associated with improvement at 6 months follow-up (Andersson, Bergström, Holländare, Ekselius, & Carlbring, 2004). Better outcomes were found for participants with higher depression severity in some studies (Ruwaard et al., 2009; Spek et al., 2007). However, in another study baseline severity of depression was not related to the effect of computerized CBT (Proudfoot et al., 2003). A recent meta-analysis of individual patient data assessed the effect of depression severity at baseline for low-intensity interventions such as guided self-help via books and the Internet (Bower et al., 2013). Results showed that patients with more severe depression at baseline demonstrate larger treatment effects than those who are less severely depressed. However, high initial scores would mean that many patients remain symptomatic after treatment and do not meet criteria for recovery (Bower et al., 2013).

Studies focusing on moderators of Internet-based treatments are almost entirely absent. Only one study evaluated moderating effects of Internet-based CBT and group CBT; participants scoring high on the personality characteristic "altruism" performed better in group CBT than in Internet-based CBT (Spek et al., 2008).

This study will examine predictors and moderators of treatment outcome, using data from our randomized controlled trial. This is crucial because several issues concerning Internet-based self-help have not yet been investigated. For example, while it contains many similarities to traditional treatment in terms of content, it cannot be assumed that the same outcome predictors will be relevant as is the case for group or face-to-face therapy. In our trial we evaluated two forms of guided Internet-based treatment, namely CBT and PST. We demonstrated earlier that both treatments are effective in reducing depressive symptoms (Warmerdam et al., 2008). One could hypothesize that pre-existing skill deficits may be predisposing factors for differential response to Internet-based CBT and PST. Cognitive restructuring and problem-solving procedures belong to the core elements of Internet-based CBT and Internet-based PST respectively. In the present investigation we tested whether baseline differences in dysfunctional attitudes and problem-solving skills predict response to these therapies. In addition, we focused on demographic variables and pre-treatment illness severity variables as it is still unknown for whom Internet-based treatment works best.

Method

Participants

A full description of the participants and the procedures can be found in our protocol article (Warmerdam, van Straten, & Cuijpers, 2007). In summary, recruitment of participants took place through advertisements in daily and weekly newspapers and via the Internet. Adults aged 18 years and older with depressive symptoms (CES-D ≥ 16) who were willing to participate in a self-help course were eligible for this study. No other inclusion or exclusion criteria were defined.

The 263 participants included in the study were randomized to one of the three conditions: Guided Internet-based CBT ($n = 88$), guided Internet-based PST ($n = 88$) and a waiting list control group with unrestricted access to usual care (WL, $n = 87$). Participants were contacted for outcome assessments at 8 weeks and 9 months after the start of the interventions. At 9 months follow-up, only data from the two intervention groups are available as participants from the WL condition had already started on the interventions. All questionnaires were administered online. A total of 173 participants (65%) provided post-treatment data, which left us with 51 participants for the CBT condition, 51 participants for the PST condition and 71 for the WL condition. At 9 months follow-up, 67 participants (38%) returned questionnaires (CBT: $n = 37$, PST: $n = 30$).

Interventions

Subjects in both interventions received weekly support through e-mail during the intervention period. Support was directed at helping the participant to work through the intervention, and not at developing a therapeutic relationship, or giving direct or individual advice on how to cope with depressive symptoms or other problems.

PST. Our PST intervention is a Dutch adaptation of Self-Examination Therapy from Bowman (Bowman, Scogin, & Lyrene, 1995). We added more information, examples, exercises and forms. PST consisted of three steps. In the first step the subjects described what really matters to them in life. Second they wrote down their current worries and problems. They divided these problems into three categories: (a) unimportant problems (problems unrelated to the things that matter to them), (b) solvable problems, and (c) problems which cannot be solved (e.g., the loss of a loved one). For each of these three types of problem a different strategy is proposed to solve the problems or to learn to cope with the unimportant and unsolvable ones. The core element of PST is to address the solvable problems by the following six-step procedure: Describing the problem, brain-storming, choosing the best solution, making a plan for carrying out the solution, actually carrying out the solution, evaluation. During the third and last step, the subjects made a plan for the future in which they described how they will try to accomplish those things that matter most to them. The course took 5 weeks and consisted of one lesson a week.

CBT. The CBT intervention was developed by the Trimbos Institute (The Netherlands Institute of Mental Health and Addiction). This intervention is based on the "Coping with Depression" course (CWD) (Lewinsohn, Antonuccio, Breckenridge, & Teri, 1984), Dutch version (Cuijpers, Bonarius, & van den Heuvel, 1995). CWD is a highly structured psycho-educational form of cognitive behavior therapy for depression. Theoretically, this course is based on the social learning theory according to which depression is associated with a decrease in pleasant and an increase in unpleasant person-environment interactions. People's problems are viewed as behavioral and cognitive patterns which can be unlearned or relearned.

CBT in this study included psycho-education and focused on skills such as relaxation, cognitive restructuring (including worrying), social skills and how to increase the number of pleasant events. The intervention made use of text, exercises, audio and video fragments. CBT consisted of eight lessons, one lesson a week. Twelve weeks later, a follow-up lesson took place.

Outcome measure

The Center for Epidemiological Studies Depression Scale (CES-D, Dutch version; Bouma, Ranchor, Sanderman, & van Sonderen, 1995) was the primary outcome measure for depressive symptoms. The CES-D is widely used for identifying people with depressive symptomatology. The CES-D consists of 20 items, and the total score varies between 0 and 60, with higher scores indicating more depression. We calculated two outcomes, i.e., improvement and clinically significant change in depression severity. The Reliable Change index was used as an index for improvement (Jacobson & Truax, 1991). The internal consistency (measured with Cronbach's alpha) of the items of the CES-D at the baseline measurement was .82 in our sample. This value was used in the formula to calculate the Reliable Change index. In order to demonstrate improvement, participants needed to show a decrease of 9 points on the CES-D. Clinically significant change means participants show

improvement as well as recovery. We used the cut-off score of 16 on the CES-D as an indication of recovery (Bouma et al., 1995).

Baseline variables

Baseline variables included socio-demographic variables, illness severity variables and specific treatment skills.

Socio-demographic variables. These factors included gender, age, education (low/middle and high), and work status (having a paid job).

Illness severity variables. These included baseline measurements of depressive symptoms, anxiety symptoms, quality of life and medication status. Depressive symptoms were measured with the CES-D.

The anxiety subscale of the Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety symptoms. The anxiety subscale consists of seven items. Scores range from 0 to 21, with higher scores indicating more anxiety. The HADS showed good homogeneity and reliability, with Cronbach's alpha ranging from .81 to .84 in various normal and clinical Dutch samples (Spinhoven et al., 1997).

Quality of life was assessed with the EuroQol Questionnaire (EQ5D) (Brooks, 1996), which is a validated tool for measuring general health-related quality of life. It consists of five items (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), each of which is rated as causing "no problems," "some problems," or "extreme problems." The EQ5D thus distinguishes 486 unique health states. Each unique health state has a utility score which ranges from 0 (poor health) to 1 (perfect health). We used this single EQ5D summary index score.

Medication status was a dichotomous variable (yes, no) indicating whether participants were using medication at baseline. We included antidepressants, anxiolytics, and benzodiazepines.

Skills. Other potential predicting variables were dysfunctional attitudes and various problem-solving skills.

The Dysfunctional Attitudes Scale (DAS) is a 40-item self-report measure designed to assess cognitive vulnerability to depression (Weismann, 1979). The DAS is one of the most widely used questionnaires for measuring cognitions in relation to depression. Scores range from 40 to 280. The Dutch version of the DAS showed good reliability and satisfactory validity (Raes, Hermans, van den Broeck, & Eelen, 2005).

The Social Problem-Solving Inventory-Revised (SPSI-R), developed by D'Zurilla, was used for measuring problem-solving skills. This questionnaire was designed to measure people's ability to resolve problems of everyday living. The SPSI-R contains 52 items and consists of the following five scales: Positive Problem Orientation (PPO), Negative Problem Orientation (NPO), Rational Problem-Solving (RPS), Impulsivity/Carelessness Style (ICS) and Avoidance Style (AS). Alphas for these five scales ranged from .76 to .92 and test-retest reliability ranged from .72 to .88 (D'Zurilla, Nezu, & Maydeu-Olivares, 1999).

Statistical analysis

All analyses were performed according to the intention to treat principle. Missing data at post-treatment were estimated using Linear Mixed Modeling (LMM). LMM includes incomplete cases in the analysis and employs restricted maximum-likelihood estimation to calculate parameter estimates. Estimated data were used in the subsequent predictor analyses. Due to the low response rate of 38% at the 9 months measurement, these data are excluded from the predictor analyses. For descriptive purposes, observed outcomes are reported for this follow-up measurement.

Predictors and moderators of outcomes were assessed at post-treatment (8 weeks after baseline). Univariate logistic analyses were conducted for each of the baseline variables. The differential effects of the baseline variables for the three groups were tested by means of reverse Helmert contrasts; PST was compared with CBT and WL was compared with CBT and PST combined. Each model included the main effect of the baseline variable on the outcomes, the interaction of the group*baseline variable and the group variable. All models were corrected for baseline depression. Analyses yielding a significant baseline variable*group interaction effect on the outcome indicated that the baseline variable was a moderator. Those yielding a significant main effect of the baseline variable in the absence of a significant interaction effect indicated that the baseline variable was a predictor.

First, baseline variables were screened to identify those with evidence of a univariate association with the outcome. Variables with $p > .20$ from the exploratory analyses were dropped from further consideration. After these exploratory analyses, baseline variables were selected for inclusion in the multivariate analysis. All continuous baseline variables were treated as continuous variables to maintain power. A stepwise backward selection procedure was employed using logistic regression. After each step

the variable with the highest *p*-value was removed from the model until the final model consisted of only significant variables ($p \leq .01$) For each variable, the odds ratio is calculated (adjusted for all other covariates in the model). The odds ratio is a measure of how much more likely (or unlikely) an event might occur in one group compared to another. All analyses were repeated for the sample that did provide post-treatment data (completers-only analysis).

Results

Participants

The average age of the participants at baseline was 45.1 years ($SD = 12.3$). Most participants were female (71.1%) and the majority (63.9%) had been educated at a high level. The mean score of the participants on the CES-D at baseline was 31.7 (*SD* 7.5, median: 31.0). There was one statistically significant difference between the groups with respect to baseline characteristics. More participants in the PST condition had been educated at a high level compared to participants in the other conditions (PST 73.9%, CBT 60.2%, WL 57.5%; $\chi^2(2, 263) = 5.86, p = .053$). No other baseline differences were found (Table I).

Main outcomes

Based on intention-to-treat analysis, the majority of the participants in the intervention groups showed reliable improvement at post-treatment (CBT 55.7%, PST 63.6%, WL 40.2%). About one-quarter of the CBT and PST participants met criteria for clinically significant change (CBT 28.4%, PST 25.0%, WL 17.2%).

Based on observed data at 9 months follow-up, 42 participants (62.7%) showed reliable change (CBT: $n = 22$, PST: $n = 20$). Clinically significant change was reached by 29 (43.3%) participants (CBT: $n = 16$, PST: $n = 13$). These follow-up data are not included in the subsequent predictor analyses.

Predictors and Moderators of Improvement at Post-Treatment

Exploratory results are shown in Table II. Only the main effects of the potential predictors are shown. The following potential predictors and moderators showed a univariate correlation of $P \leq .20$ with reliable improvement at post-treatment: Education level, work status, depression, anxiety, group*quality of life, group*anxiety, group*dysfunctional attitudes, group*negative problem orientation, group*impulsivity and group*avoidance. These potential predictors and moderators were included in the multivariate analysis.

Results of the multivariate logistic regression analysis relating predictors/moderators and reliable improvement at post-treatment are shown in Table III. Only significant variables in the final model are shown. A statistically significant predictor of a greater likelihood of improvement across all groups was higher baseline depression (OR 1.10, 95% CI 1.05–1.15, $p < .001$). Also education level predicted improvement in all groups (OR 2.41, 95% CI 1.28–4.51, $p < .01$).

Table I. Pre-treatment characteristics: Means (standard deviations) and percentages

	CBT $N = 88$	PST $N = 88$	WL $N = 87$
Demographic variables			
Age	45.7 (11.7)	45.6 (13.3)	44.1 (11.8)
Women	69.3%	64.8%	79.3%
Education level (high) [1]	60.2%	73.9%	57.5%
Paid job (yes)	52.4%	50.6%	58.3%
Severity variables			
Depression	31.2 (7.8)	31.9 (7.4)	32.1 (7.5)
Anxiety	10.6 (3.1)	10.1 (3.7)	11.3 (3.2)
Quality of life	.64 (.19)	.59 (.24)	.59 (.24)
Medication (yes)	37.0%	34.1%	34.5%
Skill variables			
Dysfunctional attitudes	152.5 (30.6)	159.7 (37.0)	153.8 (33.4)
Positive problem orientation	8.8 (2.9)	9.1 (3.3)	8.6 (2.4)
Negative problem orientation	23.4 (6.0)	23.3 (7.1)	23.8 (6.0)
Rational problem-solving	37.1 (11.8)	39.9 (11.2)	37.0 (10.2)
Impulsivity	17.2 (6.5)	15.7 (5.8)	16.4 (5.8)
Avoidance	13.4 (5.5)	13.1 (5.6)	13.4 (5.6)

Abbreviations: CBT = Cognitive Behavior Therapy, PST = Problem-Solving Therapy, WL = waiting list control group.
[1]High educational level: higher vocational education or university. Low and medium educational level = primary education, lower general secondary education, intermediate vocational education or high school.

Table II. Explorative analysis: Results from univariate logistic regression analyses.

	Improvement		Clinically significant change	
Potential predictor	OR (95% CI)	*p*	OR (95% CI)	*p*
Demographic variables				
Age	1.01 (.99–1.03)	.24	1.04 (1.02–1.07)	<.01
Gender (female)	.71 (.41–1.25)	.24	.81 (.43–1.51)	.50
Education level (high)	2.36 (1.37–4.07)	<.01	2.99 (1.46–6.12)	<.01
Paid job (yes)	.67 (.40–1.12)	.13	.97 (.54–1.76)	.92
Severity variables				
Depression	1.08 (1.04–1.12)	<.001	.95 (.92–.99)	<.05
Anxiety	.94 (.86–1.02)	.14	.90 (.81–1.00)	.05
Quality of life	1.22 (.32–4.60)	.78	1.53 (.31–7.49)	.60
Medication (yes)	.73 (.43–1.25)	.26	.75 (.40–1.41)	.38
Skill variables				
Dysfunctional attitudes	1.00 (.99–1.01)	.97	1.00 (.99–1.01)	.33
Positive problem orientation	.99 (.90–1.08)	.79	1.00 (.90–1.11)	.99
Negative problem orientation	.98 (.94–1.03)	.39	.96 (.91–1.01)	.13
Rational problem-solving	.99 (.97–1.02)	.47	.98 (.96–1.01)	.19
Impulsivity	.98 (.94–1.03)	.41	1.02 (.97–1.07)	.53
Avoidance	1.00 (.95–1.04)	.82	.93 (.88–.99)	<.05

Note. Only results of the main effects are shown.

A high education level increased the likelihood of improvement by 2.41 compared with participants who had a low or medium educational level. A negative problem orientation differentially predicted improvement; a more negative problem orientation decreased the odds of improvement in the control group by 0.86 compared to both interventions (conversely, a more negative problem orientation increased the likelihood of improvement in both intervention groups).

Predictors and Moderators of Clinically Significant Change at Post-Treatment

In addition to reliable improvement, we explored predicting and moderating variables of clinically significant change in depressive symptoms (Table II). Variables with a univariate correlation of $p \leq .20$ were age, education, depression, anxiety, negative problem orientation, rational problem-solving, avoidance and group*quality of life. These variables were included in the multivariate analysis.

Logistic regression analysis showed that education significantly predicted clinically significant change at post-treatment across all groups (education: OR 3.55, 95% CI 1.63–7.74, $p < .01$). See Table III. More highly educated participants were over three times more likely to change than low to middle educated participants. Furthermore, higher baseline scores on avoidance and rational problem-solving corresponded with a lower likelihood on clinically significant change (avoidance: OR 0.90, 95% CI 0.84–0.97, $p < .01$; rational problem-solving: OR 0.96, 95% CI 0.93–0.99, $p = .01$). No significant moderators were found for clinically significant change.

We explored the relationship between baseline depression and clinically significant change further as baseline depression was a predictor of improvement and not of clinical change. Of the participants with moderate symptoms at baseline (CES-D score between 16 and 32), 25% showed clinically signifi-

Table III. Odds ratios (95% CI) for the final multivariate model for the prediction of improvement and clinically significant change in depressive symptoms after treatment (based on intention-to-treat analysis)

	Improvement		Clinically significant change	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Predictor				
Education level (high)	2.41 (1.28–4.51)	<.01	3.55 (1.63–7.74)	<.01
Depression	1.10 (1.05–1.15)	<.001		
Avoidance			.90 (.84–.97)	<.01
Rational problem-solving			.96 (.93–.99)	.01
Moderator				
Negative problem orientation*WL[1]	.86 (.78–.95)	<.01		

[1]: WL: waiting list control group, both interventions form the reference group.

Table IV. Odds ratios (95% CI) for the final multivariate model for the prediction of improvement and clinically significant change in depressive symptoms after treatment (based on completers-only analysis)

	Improvement		Clinically significant change	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Predictor				
Education level (high)	3.39 (1.60–7.18)	<.01		
Avoidance			.90 (.83–.97)	<.01
Rational problem-solving			.95 (.91–.98)	<.01

cant change, while this was 20% for the participants with severe depression scores at baseline (CES-D $\geq$ 32). The differences was not significant ($\chi^2(1,263) = .81$, $p = .38$). The group with moderate baseline scores ended up with lower depression scores after treatment compared with the group with severe baseline scores (18.9 versus 24.8). This difference was significant ($t(261) = 5.39$, $p < .001$).

Completers-Only Analysis

Logistic regression analysis was performed on the completers-only sample. In the final multivariate model, the results were partly comparable to the intention-to-treat analysis (Table IV). A high education level increased the likelihood of improvement. For clinically significant change, more highly educated participants were more likely to report clinically significant change than low to middle educated participants. And participants with higher baseline scores on avoidance and rational problem-solving had lower odds on clinically significant change.

Discussion

Main Findings

Our aim was to identify predicting and moderating variables of response to guided Internet-based CBT and guided Internet-based PST. Higher baseline depression and a high education level predicted improvement, whereas a high education level and lower scores on avoidance and rational problem-solving predicted clinically significant change across all groups. A more negative problem orientation increased the likelihood of improvement for participants in both intervention groups compared to the control group. We found no variables that differentially predicted outcome for the two interventions.

Comparison with Prior Work

Most of the predictors of depression outcomes in this study were found across the three groups, including the waiting list control group. Importantly, the predictors thus hold not only for Internet-based treatment but also for spontaneous recovery during a waiting list condition.

The only variable that moderated the outcome between the interventions and the control group was the subscale "negative problem orientation." Participants with a more negative problem orientation benefited more from Internet-based treatment than participants in the waiting list group. People who have a negative problem orientation tend to view problems as threats, expect problems to be generally unsolvable, have doubts about their ability to solve problems successfully, and become especially frustrated and upset when faced with problems. It might be the case that participants with a more negative problem orientation are more sensitive to improvement from CBT and PST in which they learn strategies on how to deal with their problems and symptoms. However, a negative problem orientation predicted only improvement and not clinically significant change and these results were not found in the completers sample. This could imply that these findings are not that robust and might largely be psychometric findings.

The fact that we found few moderators could be due to low power to detect these subgroups or that we didn't measure the right moderating variables. It's also possible that the two treatments are more similar than we think and that moderators will appear when treatments are more different from each other. It might also be that there are few subgroups that responded in a significantly different way to CBT and PST. That is, differences in problem-solving level or level of dysfunctional attitudes did not lead to a differential effect of the interventions.

One of the variables that predicted improvement across the three groups was severity of depressive symptoms, with higher baseline depression showing a greater likelihood of improvement. This can be explained by the fact that higher scores leave more room for improvement, which replicates earlier findings (Ruwaard et al., 2009; Spek et al., 2008). This result is also in line with findings from a meta-regression analysis (Bower et al., 2013). However, as the data of our study were part of that meta-regression analysis, the analyses of both studies are not completely independent of each other.

A more strict outcome measure reflecting change in depression is clinically significant improvement consisting of reliable improvement and a score below the cut-off point of 16 on the CES-D. High education level had a positive effect on clinically significant change. This differs from earlier studies, where no significant results were found for educational level as a predictor of depression outcome during traditional CBT (Neimeyer & Weiss, 1990; Jarrett et al., 1991), although high education level was associated with better treatment outcome for group- and Internet-based CBT for depression (Spek et al., 2008). Differences in study design, treatment format and populations might account for differences in results between studies.

Interestingly, baseline severity of depressive symptoms was not significantly related to clinically significant change. That is, baseline depression had no influence on whether participants changed to a clinically significant and reliable degree. Explorative analyses comparing two groups with respectively moderate and severe baseline depression also showed no relation between baseline depression and clinically significant change, although the severe group ends up with more symptoms after treatment. Comparison with previous work is difficult, as we know of no Internet-based studies that relate baseline depression to clinically significant change. Our finding that severity of symptoms is related to improvement but not to clinically significant change corresponds with findings from a review which indicated that the relationship between depression severity and outcome of traditional psychotherapy partly depends on how depression outcome is defined (Van, Schoevers, & Dekker, 2008).

Limitations

This study has some limitations. We had a relatively high attrition rate regarding returned questionnaires at post-treatment. Although we used maximum-likelihood estimation to handle missing data, imputing data could have introduced some bias. Maximum-likelihood estimation is, however, a highly recommended method (Schafer & Graham, 2002). Second, the participants in this study were self-selected. As a result the demographic characteristics did not constitute a representative sample of the general population. For example, participants were mainly highly educated and female, which makes it difficult to estimate the predictive value of education and gender. A third limitation is the omission of interaction effects between the identified predictors. It could be, for example, that the relationship between education and outcome itself is moderated by other variables. These relationships might be explored in future studies that have sufficient power to detect these interactions. Fourth, we did not measure other potentially predicting/moderating variables that could be of interest, such as factors related to Internet use, treatment credibility, expectations and personality characteristics. Fifth, participants who showed improvement form a subgroup of the participants who showed clinically significant change. Therefore, the analyses are not independent of each other. And finally, few data were available at the 9 months measurement, preventing us from analyzing predictors of outcome in the long term.

Conclusions

This study indicates that depression outcomes are partly predicted by different participant characteristics. Predicting variables are dependent on how outcome and effect are defined. Improvement, regardless of the condition (treatment or waiting list), is best predicted by higher baseline depression and higher education level, while clinically significant change is predicted by higher education level, decreased avoidance behavior and less rational problem-solving skill. If our findings could be replicated and if more studies investigate predictors and moderators of response, we could make more educated decisions about treatment allocation of participants. The predicting variables of outcome might then be used to identify participants for whom longer treatment or treatment in other formats is needed.

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